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(56) Documents Cited
US 4521265 A

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(54) Abstract Title
Producing a composite laminate

(57) A composite laminate (8) is continuously produced by extruding a thermoplastic synthetic resin (411) from an outlet (412) of an extruder (411) to form a synthetic resin core sheet (43) with the major surfaces thereof being adhesive surfaces; providing a pair of front press rollers (51) immediately downstream of the extruder (41), the front press rollers (51) defining a first clearance (511) therebetween for forming a pre-pressed laminate (43'); feeding first and second metal foil sheets (42) to the front press rollers (51) prior to forming the pre-pressed laminate (43'); providing a pair of rear press rollers (52) which define a second clearance (521) downstream of the front press rollers (51), the outlet (412) of the extruder (41) and the first and second clearances (511, 521) being located along a straight path; and providing a middle press roller (6) between the front and rear press rollers (51, 52) to laterally depress the pre-pressed laminate (43,) in a direction transverse to the straight path.

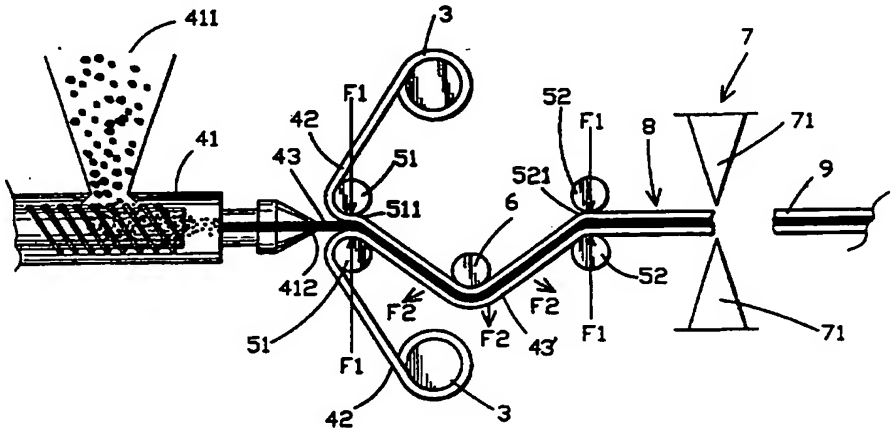

FIG. 1

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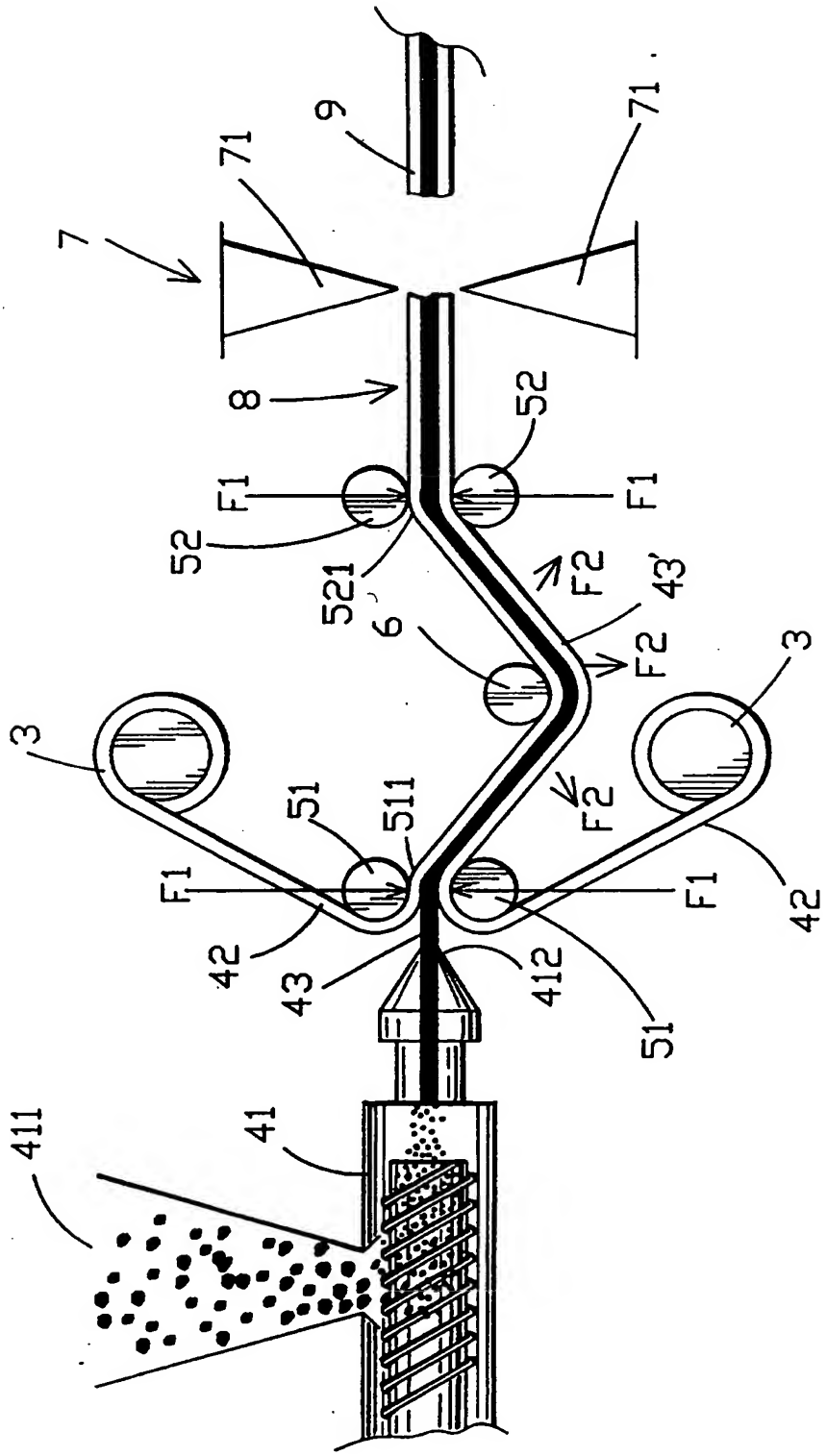
9
71
71
7
8
52
F1
F1
52
521
F2
43'
6
F2
3
3
51
511
F2
F1
F1
42
42
43
412
51
411
41

FIG. 1

METHOD AND APPARATUS FOR PRODUCING A COMPOSITE LAMINATE

This invention relates to a method and apparatus for producing a composite laminate, more particularly to a method and apparatus for continuously producing a composite laminate.

Composite laminates that are manufactured by bonding manually a plurality of sheet materials with the use of adhesives are well known in the art. The sheet materials of the composite laminates are liable to separate from one another because of failure of the adhesives after the composite laminates have been in use for a period of time. To overcome this problem, another conventional method for producing a composite laminate involves depressing the composite laminate in a direction generally perpendicular to the opposite side faces of the composite laminate while the sheet materials are adhered to one another in order to improve the bonding strength of the sheet materials. However, the bonding strength between the sheet materials is still not satisfactory.

The object of the present invention is to provide a method and apparatus for producing a composite laminate which has a plurality of sheet materials that are bonded to each other with an enhanced bonding strength.

According to one aspect of the present invention, a method for continuously producing a composite laminate having a thermoplastic synthetic resin core sheet and two metal foil sheets laminated respectively on two major surfaces of the synthetic resin core sheet, the major surfaces of the synthetic resin core sheet being adhesive surfaces, comprises the steps of:

extruding, from an outlet of an extruder, a thermoplastic synthetic resin that serves as the synthetic resin core sheet;

providing a pair of front press rollers immediately downstream of the extruder, the front press rollers defining a first clearance therebetween for forming a pre-pressed laminate;

feeding first and second metal foil sheets to the pair of front press rollers so as to sandwich the synthetic resin core sheet between the first and second metal foil sheets immediately prior to forming the pre-pressed laminate;

providing a pair of rear press rollers downstream of the front press rollers, the rear press rollers defining a second clearance therebetween for pressing and discharging the composite laminate, the outlet of the extruder, the first and second clearances being located along a straight path; and

providing a middle press roller between the front and rear press rollers to laterally depress the pre-pressed laminate in a direction transverse to the straight path so as to subject the pre-pressed laminate to a prescribed tension while the pre-pressed laminated is being pressed by the front and rear press rollers, thereby increasing the bonding strength between the major surfaces of the synthetic resin core sheet and the first and second metal foil sheets.

According to another aspect of the present invention, an apparatus for continuously producing a composite laminate having a thermoplastic synthetic resin core sheet and two metal foil sheets laminated respectively on two major surfaces of the synthetic resin core sheet, the major surfaces of the synthetic resin core sheet being adhesive surfaces, comprises:

an extruder having an outlet adapted for extruding a thermoplastic synthetic resin in molten state to form the synthetic resin core sheet;

a pair of front press rollers disposed immediately downstream of the extruder, the front press rollers defining a first clearance therebetween that is aligned with the outlet so that the front press rollers are adapted to draw the synthetic resin core sheet from the outlet therethrough;

means for feeding first and second metal foil sheets to the pair of front press rollers so as to sandwich the synthetic resin core sheet between the first and second metal foil sheets immediately prior to drawing of the synthetic resin core sheet through the first clearance so that a pre-pressed laminate is drawn out from the front press rollers away from the extruder;

a pair of rear press rollers disposed downstream of the front press rollers, the rear press rollers defining a second clearance therebetween so that the rear press rollers are adapted to press and continue drawing the pre-pressed laminate through the second clearance, the outlet of the extruder and the first and second clearances being located along a straight path; and

a middle press roller interposed between the front and rear press rollers and adapted to laterally depress the pre-pressed laminate in a direction transverse to the straight path so as to subject the pre-pressed laminate to a prescribed tension while the pre-pressed laminate is being pressed by the front and rear press rollers, thereby increasing the bonding strength between the major surfaces of the synthetic resin core sheet and the first and second metal foil sheets.

A preferred embodiment of the invention will now be

described, by way of example only, and with reference to the accompanying drawing, in which

Figure 1 is a schematic view illustrating how a preferred embodiment of an apparatus for continuously producing a composite laminate operates according to a method for continuously producing the composite laminate of the present invention.

Referring to Figure 1, a preferred embodiment of an apparatus for producing a composite laminate 8 by means of a method for continuously producing the composite laminate 8 according to the present invention is shown to comprise an extruder 41, a pair of front press rollers 51, feeding means 3, a pair of rear press rollers 52, a middle press roller 6 and cutting means 7.

Thermoplastic synthetic resin 411 is fed into the extruder 41 and is heated to form a melt. The resin 411 in molten state is extruded from an outlet 412 of the extruder 41 to form a synthetic resin core sheet 43. A bonding agent is blended with the resin 411 in the extruder 41 so that the major surfaces of the core sheet 43 are adhesive surfaces when the core sheet 43 is extruded from the outlet 412. A foaming agent and a fire-retardant agent may be blended with the resin 411 in order to foam the core sheet 43 and provide the same with a fire-retardant characteristic. Instead of being blended with the resin 411, the bonding agent

may be coated on the major surfaces of the core sheet 43 immediately after the core sheet 43 exits the outlet 412 of the extruder 41 in order to provide the major surfaces with adhesive qualities.

The front press rollers 51 are disposed immediately downstream of the extruder 41 and define a first clearance 511 therebetween which is aligned with the outlet 412 so as to draw synthetic resin core sheet 43 therethrough. The feeding means 3 feeds first and second metal foil sheets 42 to the front press rollers 51 in order to sandwich the core sheet 43 between the metal foil sheets 42 immediately prior to drawing of the core sheet 43 through the first clearance 511 to form a pre-pressed laminate 43'. Two vertical compression forces (F1) are exerted respectively onto the metal foil sheets 42 by the front press rollers 51 before the pre-pressed laminate 43' is drawn out from the front press rollers 51 away from the extruder 41 in order to ensure firm adhesion between the core sheet 43 and the metal foil sheets 42.

The rear press rollers 52 are disposed downstream of the front press rollers 51 and define a second clearance 521 therebetween. The rear press rollers 52 press and continue drawing the pre-pressed laminate 43' through the second clearance 521 in order to form the composite laminate 8. Two vertical compression forces (F1) are also exerted onto the pre-pressed

laminate 43' in order to further ensure firm adhesion between the core sheet 43 and the metal foil sheets 42. The outlet 412 and the first and second clearances 511, 521 are located along a straight path.

The middle press roller 6 is interposed between the front and the rear press rollers 51, 52 to laterally depress the pre-pressed laminate 43' in a direction transverse to the straight path so as to subject the pre-pressed laminate 43' to a prescribed tension (F2) while the pre-pressed laminate 43' is being pressed by the front and rear press rollers 51, 52, thereby increasing the bonding strength between each of the major surfaces of the core sheet 43 and the corresponding one of the first and the second metal foil sheets 42.

Finally, the composite laminate 8 is cut into a plurality of composite laminate plates 9 of a predetermined length by the cutting means 7. In this embodiment, the cutting means is two opposed cutting knives 71.

It is noted that the composite laminate 8 can be produced continuously by the method of the present invention, thereby increasing the manufacturing speed and reducing the manufacturing cost. In addition, the front, rear and middle press rollers 51, 52, 6 can exert compression forces of different orientations, thereby enhancing the bonding strength between the core sheet

43 and the metal foil sheets 42.

CLAIMS:

1. A method for continuously producing a composite laminate having a thermoplastic synthetic resin core sheet and two metal foil sheets laminated respectively on two major surfaces of the synthetic resin core sheet, the major surfaces of the synthetic resin core sheet being adhesive surfaces, said method comprising the steps of:

extruding, from an outlet of an extruder, a thermoplastic synthetic resin that serves as the synthetic resin core sheet;

providing a pair of front press rollers immediately downstream of said extruder, said front press rollers defining a first clearance therebetween for forming a pre-pressed laminate;

feeding first and second metal foil sheets to said pair of front press rollers so as to sandwich the synthetic resin core sheet between the first and second metal foil sheets immediately prior to forming the pre-pressed laminate;

providing a pair of rear press rollers downstream of said front press rollers, said rear press rollers defining a second clearance therebetween for pressing and discharging the composite laminate, said outlet of said extruder and said first and second clearances being located along a straight path; and

providing a middle press roller between the front and rear press rollers to laterally depress said pre-pressed laminate in a direction transverse to said straight path so as to subject the pre-pressed laminate to a prescribed tension while the pre-pressed laminate is being pressed by said front and rear press rollers, thereby increasing the bonding strength between the major surfaces of the synthetic resin core sheet and the first and second metal foil sheets.

2. The method for continuously producing a composite laminate as claimed in Claim 1, further comprising the step of cutting the composite laminate into a plurality of composite laminate plates of a predetermined length.

3. An apparatus for continuously producing a composite laminate having a thermoplastic synthetic resin core sheet and two metal foil sheets laminated respectively on two major surfaces of the synthetic resin core sheet, the major surfaces of the synthetic resin core sheet being adhesive surfaces, said apparatus comprising:

an extruder having an outlet adapted for extruding out a thermoplastic synthetic resin in molten state to form the synthetic resin core sheet;

a pair of front press rollers disposed immediately downstream of said extruder, said front press rollers defining a first clearance therebetween that is aligned with said outlet so that said front press

rollers are adapted to draw the synthetic resin core sheet from said outlet therethrough;

means for feeding first and second metal foil sheets to said pair of front press rollers so as to sandwich the synthetic resin core sheet between the first and second metal foil sheets immediately prior to drawing of the synthetic resin core sheet through said first clearance so that a pre-pressed laminate is drawn out from said front press rollers away from said extruder;

a pair of rear press rollers disposed downstream of said front press rollers, said rear press rollers defining a second clearance therebetween so that said rear press rollers are adapted to press and continue drawing said pre-pressed laminate through said second clearance, said outlet of said extruder and said first and second clearances being located along a straight path; and

a middle press roller interposed between said front and rear press rollers and adapted to laterally depress the pre-pressed laminate in a direction transverse to said straight path so as to subject the pre-pressed laminate to a prescribed tension while the pre-pressed laminate is being pressed by said front and rear press rollers, thereby increasing the bonding strength between the major surfaces of the synthetic resin core sheet and the first and said second metal foil sheets.

4. The apparatus for continuously producing a composite laminate as claimed in Claim 3, further comprising cutting means adapted for cutting the composite laminate into a plurality of composite laminate plates of a predetermined length.

5. A method for continuously producing a composite laminate substantially as hereinbefore described with reference to and as illustrated in the accompanying drawing.

6. An apparatus for continuously producing a composite laminate substantially as hereinbefore described with reference to and as illustrated in the accompanying drawing.

The Patent Office

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Claims searched: 1 to 6

Examiner: R.J.MIRAMS
Date of search: 6 March 1998

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): B5N

Int Cl (Ed.6): B32B 15/08, 31/00, 31/20.

Other: ONLINE: WPI,CLAIMS.

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	US4521265A (Kunihiko) whole document	at least 1 and 3

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.